"MUNICIPAL SOLID WASTE TO ELECTRICITY"

RECOMMENDATIONS FOR PROJECT

IN BANGKOK, THAILAND

ENGINEERING & ECONOMICS RESEARCH, INC.

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Submitted to:

The U.S. Trade and Development Program
Washington, D.C.

By:

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1.0 FEASIBILITY STUDY FOR DEVELOPING AN INDUSTRY BASED ON REFUSE AND WASTE AS RAW MATERIAL IN THAILAND - TERMS OF REFERENCE

1.1 BACKGROUND

The Bangkok Metropolitan Area has a current population of 6 million. Approximately 1 million metric tons of city and urban refuse is produced in the area every year. Recent estimates indicate that the yearly quantity of refuse is expected to double during the next decade, whereas the population of the Bangkok Metropolitan Area, is expected to increase to 8 million residents.

Bangkok Metropolitan Administration (BMA) is charged with the responsibility of public cleansing and waste disposal in the metropolitan area. BMA operates 600 trucks which collect the waste twice a day and dump it at its three sites located in the Huai Kwong, Bangkok Noi and Rataburana districts. Presently these trucks collect 3,000 metric tons of garbage per day.

At the waste dump sites, which are rapidly overflowing, BMA presently operates four compost plants, three with input capacity of 320 tons per day each and a fourth which uses about 160 tons of garbage per day -- thus utilizing about 1,120 tons of garbage per day. The efficiency of compost production is about 25 percent and, therefore, a total of approximately 840 tons of residue garbage per day is left at the three sites in addition to about 1,880 tons per day of unused garbage. There is no organized pre-sorting of the city's waste either at the collection points or at the dump sites, except that a considerable amount of presorting of glass, metal and plastics is carried out by the truck drivers and the local residents at

or around the sites. Some of this presorted waste is sold to industry for recycling.

Creation of new sites would require going even farther away from city, resulting in excessive transportation costs. Furthermore, it is difficult to find new dump sites as the residents object to having waste located near residential areas.

Despite the production of significant quantities of natural gas, Thailand is still dependent on imported petroleum for about 60 percent of its total energy requirements. In 1983, the cost of imported petroleum was about 37 percent of Thailand's total exports.

As such, acceleration of the development of indigeneous sources of energy has been a national policy in Thailand. Among domestically available sources of energy, Municipal Solid Waste (MSW) has been considered as a significant source and at the same time an option for managing the city's waste problem.

National Energy Administration (NEA) is the agency charged with coordinating the development of the national energy policy. Recognizing the potential benefits of the utilization of MSW, NEA carried out a preliminary feasibility study in 1971 with assistance from France. However, because of cheap oil prices, the Government did not pursue this effort further.

In 1979, the Government began implementing energy price increases in response to world oil prices and over the last 5 years brought the petroleum product prices above international levels. The price structure, however, still remains inefficient and the Government of Thailand is considering major reforms in its price structure for petroleum products.

Rising costs of fossil fuels and increasing problems of MSW disposal, resulted in the Government seeking assistance from Japan International Cooperation Agency (JICA) to conduct a study on MSW management options. This comprehensive study was carried out during the period 1980-82 with close cooperation and guidance from the BMA.

In 1984, the Government also began discussions with the U.S. Embassy's Commercial Office and made a formal request in January 1985 to seek assistance from the U.S. Trade and Development Program for carrying out a detailed study in this area. In April 1985, the USTDP engaged the firm of Engineering and Economic Research (EER), Inc. to carry out a definitional/prefeasibility study to assess the potential of a project for MSW management and energy production utilizing city and urban waste. The EER mission consisting of Mr. Vinod Shrivastava (Mission Leader) and Mr. William Jones (MSW Technology Expert) visited Thailand for 3 weeks to collect preliminary data and hold discussions with Government officials.

Based on preliminary analysis, the EER team has recommended that a detailed feasibility study be carried out to access the potential to develop three integrated facilities, one at each site, which will rehabilitate the compost production as well as utilize 2,779 tons/day of waste for on-site power generation. The preliminary analysis indicates that each of the three plants could produce 4MW-8MW of electricity, thus resulting in a total of 20 MW of electric power.

2.0 COMPARISON OF THE JAPANESE INTERNATIONAL COOPERATION AGENCY (JICA) STUDY AND EER STUDY

In this addendum a comparison of the comprehensive study done by the Japanese International Cooperation Agency (JICA) and the pre-feasibility study of the Engineering and Economics Research Inc., (EER) is presented. The objectives of the studies are presented with their structure and proposed options.

2.1 The JICA Study

The 28 month study (June 1980 - September 1982) was conducted in two phases and aimed at finding solutions to problems that were already evident in Bangkok's waste management system. Implementation of the proposed project study was set for the year 2000, and the coverage was limited to 24 districts in Bangkok City.

2.1.1 Primary Objectives

The Bangkok Metropolitan Administration stated its primary objectives as:

- Ensuring a cleaner Bangkok.
- Utilizing city compost effectively.

2.1.2 Other Objectives

The JICA study team considered the above objectives in the context of the following consideration:

- Total volume of weekend waste.
- Total volume of waste for treatment and disposal.
- Establishment of a reliable solid waste management system.

- Promotion of citizen cooperation.

The formation of the master plan was set in place after surveys and data collection. A short term improvement plan was executed and targeted for a 5 year period (from fiscal 1982 to 1986). The plan listed 67 short term improvement items that were extracted from the surveys by way of evaluation and screening; the items highlighted the improvement of problems outlined under the existing administrative and financial conditions of the B.M.A.

The 67 items were listed under categories of:

- Discharge and collection
- Transportation
- Compost Plan
- Final disposal system
- Administrative system
- Measures during flood

2.1.3 Phase II (Options)

Based on the data and results of Phase 1 a technical study was conducted with regard to Bangkok's current solid waste management capability, in order to acertain the technological applicability to future forecast of solid waste conditions.

The surveys and evaluations in this phase were formulated into a 30 case master plan of alternatives based on solid waste collection, transport, intermediate treatment and final disposal. Another screening and evaluation

process was reconducted to identify the alternatives most suitable for a specific case or option.

Of the 30 cases evaluated, 3 alternatives were further selected for the optimum plan (see Exhibit 2.1). The evaluation factors were based on indepth studies of:

- Economy of operation
- Environmental protection
- Resource recovery
- Administrative circumstances
- Technology

An outline of the 3 appropriate master plan alternatives is shown in (Exhibit 2.2).

2.2 EER's Prefeasibility Study

The 3 week prefeasibility study conducted in Bangkok by the EER's team of consultants focused generally on the waste management system currently in place and more specifically on the preassessment of the feasibility of electric power generation utilizing an integrated municipal solid waste recovery system.

2.2.1 Objectives

EER's study is concurrent with the national objectives some of which are:

- To investigate and direct the present energy mix toward a more significant use of indigenous energy resource and away from imported petroleum.

EXHIBIT 2.1

THE MASTER PLAN ALTERNATIVES (3 OF 30 Case Evaluated)
(JICA)

Alternative Treatment & Disposal System	Case No.	Number of Treatment and Disposal Facilities				Outline of Features of the Master Plan Alternatives	Purposes
		Incineration Plant	Compost Plant	Final Disposal Site	Transfer Station		
Composting and Landfill	9		5	5		Demand for compost is assumed (1,920 t/d). The existing plants are utilized. Surplus waste for composting is landfilled.	Formulation of number location and capacity of additional plants to satisfy the increased compost demand.
Incineration and Composting	13	4	5			Compost demand 1,920 t/d. The existing compost plants are used. Surplus solid waste is incinerated.	To examine establishment of incineration plants and additional compost plants to satisfy increasing compost demand.
Incineration and Composting and Landfill	19-2	2	5	5		Two incineration plant at the most suitable place. Compost demand 1,920 t/d. Use of existing compost plants.	Combination of the minimum cost with increased compost demand: examination of balance between collection/transport cost and expanded facilities cost from addition of incineration plant. Study of the total cost.

EXHIBIT 2.2

OUTLINE OF APPROPRIATE MASTER PLAN ALTERNATIVES (JICA)

Type of Treatment and Disposal	Case No.	Treatment Disposal Volume (t/d)			Location of the Facilities and the Capacity* (t/d)		
		Composting	Incineration	Landfill	Compost Plant	Incineration	Landfill Site**
Compost and Landfill	9	1,630	0	3,910	Existing 4 plants (1,120); Bang Khun Tian (260). Taling Chan (540)	No plant	Non-Nooch none Khaem Ram Intra
Compost and Incineration	13	1,630	3,910	0	Same as above	Yannawa (1,500) Bane Kapi (1,200) Bankok Noi (1,100) Phasi Charoen (1,100)	On-Nooch None Khaem
Compost and Incineration and Landfill	19-2	1,630	2,400	1,510	Same as above	Yannawa (1,500) Dusit (1,500)	On-Nooch None Khaem Ram Intra

*Capacity of each facility was estimated assuming the operating rate of the compost plant to be 0.85 and that for the incineration plant 0.8.
**Landfill sites in case No. 13 are for disposal of intermediate treatment residue.

- To investigate the economic and financial viability of a MSW electric power generation plant.
- To establish an efficient and reliable solid waste management system.

2.2.2 Option

EER's study, as presented in this report, was intensively conducted with the assistance of the N.E.A. and B.M.A. officials. The observations were focused on three sites namely Ram Intra, On Nooch, and Nong Khaem where electric power generation could be financially viable.

Data collected and the results of interviews with senior government officials were evaluated and weighed for the most feasible options. The options are shown in Exhibit 2.3 of the report.

The EER study examines the four concepts (See Exhibit 2.3) of refuse treatment and disposal processes for the sites observed. Final decision was based on the potential revenues from the sale of electricity, compost, tipping fees and the resource recovery sales.

It is suggested that a more detailed observation should follow the prefeasibility study in order to quantify parameters that were not available at the preliminary stage of observations.

2.3 Comparison Of The JICA And EER Reports

Of the 3 appropriate (JICA) master plan alternatives chosen, case 19-2 was selected (as it reflected the highest rank in the overall evaluation), it was given priority in ranking for the best case in light of administrative and technical credits. Case number 9 was next in rank, followed by case number 13.

EXHIBIT 2.3
EER's RECOMMENDED OPTION

Type of Treatment and Disposal	Recommended Option	Treatment/Disposal (Total Volume)			Location of Facilities and Power Capacity	
		Composting t/d	Electricity Generation t/d	Landfill t/d	Landfill Site	Electricity Generation
Composting	↑	1,120	-	-	Ram Intra	4 MW
Landfill	↕	-	-	1,939	On-Nooch	8 MW
					Nong Khaem	8 MW
Electric Power Generation	↓	-	2,779	-	Total	20 MW

Comparison between case 19-2 of the JICA study and the recommended option of the EER study is presented in this subsection.

2.3.1 Similarities

- The objectives presented were similar in terms of approach and consequences to the economy.
- Both study teams used a common basis and factors for structuring their observations. The similar areas were, the economy, environmental impact, resource recovery, technology and administrative circumstances.
- Economic and financial justifications of the selected options were carried out in both studies.

2.3.2 Differences

- While resembling case 19-2 of the JICA report in terms of treatment type and landfill disposal, the EER option does not include incineration as a means, but promote electric power generation as a mechanism for conserving resources and improving the economic viability of the project.
- The time frame for the EER study was much shorter than that of the JICA study.
- Incineration as outlined in the JICA report, provides a social benefit, but does not give account for the financial benefit, if any, to be derived. The EER study recognizes a financial benefit.
- The climate for added and advanced technology is being introduced with the concept of electric power generation by EER; the incineration for volume reduction process does not bring a new or advanced technology.
- If the present rate of 6.6% B.M.A. allocation to sanitation management is kept in the future, only case 9 of the JICA appropriate master plan would show signs of becoming financially feasible.
- Case 9 of the JICA study involves composting and landfill. The EER option offers composting, landfill and electric power generation.
- Cases 13 and 19-2 of the JICA study would not be practical and feasible unless a B.M.A. budget increase was forthcoming. The EER's electric power generation concept and recommendation views modest

financial rates of returns, made under very conservative estimates and does not require any budget increases on the part of B.M.A.

2.4 Conclusion

In comparing the option of JICA case 19-2 with that of EER's proposal for the electric power generation facility, the economic and financial benefits appear to be in favor of the electric power generation facility over incineration as an end use.

3.0 RECOMMENDATIONS FOR FOLLOW-ON ACTIVITIES

Based on this preliminary feasibility study, we are recommending the following activities:

- The Thai Government should consider proceeding to the next stage which would require a detailed feasibility study of the project proposed in this report.

- Prior to beginning the detailed feasibility study, the Government should undertake measurements for the moisture content and the heat content of the MSW. This activity was discussed with the Thai officials and agreement reached that these results will be provided to the consultant selected for carrying out the feasibility study.

- NEA and BMA should set up a Project Operation and Coordination Committee which should supervise the next stage activities.

- The Government should formally request the U.S. Trade and Development Program to fund the next stage study.

- As part of the next stage, the consultant should also carry out a market study to assess the size of the domestic and foreign market for the compost. This activity should be carried out in the early stages and the results should be used to redefine the electricity generation component of the project.

- The Government of Thailand should ensure the involvement of the private sector during the feasibility study to guide the consultant concerning the most realistic investment elimate in Thailand.

- BMA and NEA should examine the existing legislation, particularly those aspects which may preclude private sector involvement and begin the process for ammending such provisions to ensure private sector operation and management of this project.